Household Use of Biomass Energy among the Urban Poor: Case Studies in Kibera Slums of Kenya

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ABSTRACT

Woody biomass, especially charcoal, is an important energy source in Kenya. Urban households in informal settlements rely almost entirely on charcoal for their basic cooking energy needs. Population increases and urbanization have led to the increased demand for charcoal in sub-Saharan Africa (SSA). This trend, coupled with the inefficient charcoal production and consumption technologies and households' inaccessibility to other modern energy sources, is not likely to change in the near future. Charcoal production is considered the major cause of deforestation, mostly on account of unsustainable harvesting and inefficient production techniques. Further, about 10–15% of charcoal is wasted along the supply chain to form dust or fines from breakages during handling; this dust can be mainly found at the retail and wholesale stalls. Faced with the disposal challenges of charcoal dust, slum communities turn to making charcoal briquettes with the dust recovered from among the other organic by-products. In Kenya, the use of fuel briquettes is spreading among the urban and rural households and there is a huge potential for briquettes to become an affordable and good cooking fuel.

Meanwhile, substituting charcoal with electricity and/or liquid petroleum gas (LPG) should be one of the remedies to reduce the pressures of deforestation and health risks from indoor pollution. With regard to the relationship between household economic growth and energy consumption, some empirical and micro-level studies have presented the 'energy ladder' hypothesis, which states that an increase in income helps households shift their energy sources from traditional biomass to modern fuels. However, differing with the energy ladder hypothesis, there is an argument that households in developing countries do not switch to modern energy sources but rather tend to consume a combination of fuels. We consider it crucial to understand the factors that affect the consumption patterns of cooking energy, that is, the substitution and diversification of energy sources, of the lower-income urban households in SSA, rather than simply assuming the energy ladder hypothesis. We need a more policy-relevant and realistic theory of household energy demand, because the benefit of policies that ignore fuel stacking may be less than hypothesized. It is urgent to enhance the understanding of the transition

from charcoal to kerosene, which is the most important modern energy option for the poor in Nairobi, and the adoption of charcoal briquette as a substitute/complement to charcoal.

The primary aim of this study is to better understand the relative importance of fuel substitution and fuel complementation, especially with regard to charcoal, fuel briquettes, and kerosene. More specifically, we analyse the determinants of the fuel preferences of urban poor households. For this, we use a choice experiment based on a stated preference survey of slum dwellers of Nairobi and a conditional logit (CL) model and a random parameter logit (RPL) model.

In this study we present results of a household survey conducted during October 2010 in Kibera slums in Nairobi, Kenya. The results revealed that widely various household characteristics influence demand for charcoal and briquettes for cooking. In addition to these factors, the household income level affects the use of kerosene for cooking. As the results have shown, households currently do not have a strong relative preference for charcoal briquettes over charcoal and kerosene. At the same time, we found the fact households tend to switch to multiple fuels strategy as their increasing in income instead of completely switching from the consumption of traditional fuels to modern energy sources.

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INTRODUCTION

1.1 Background

Traditional wood-based biomass, especially charcoal, is an important energy source in Kenya. Urban households in informal settlements rely almost entirely on charcoal for energy, especially for cooking. Although urbanization brings people physically closer to centralized electricity systems, limited economic and job opportunities often mean that the majority of the urban poor cannot access electricity and thus do not transition to using modern energy sources. Population growth and urbanization have led to increased demand for charcoal in sub-Saharan Africa (SSA). According to the World Bank, biomass use in SSA is expected to increase over the next twenty years. This trend, coupled with inefficient charcoal production and consumption technologies and households' inaccessibility to other modern energy sources, is not likely to change in the near future. The impacts of continued biomass energy use are observed across many sectors of society, such as health, agriculture, forestry, education, economy, trade, and environment. The important role and various impacts of biomass energy have not gone unnoticed, and many countries in SSA are now beginning to address biomass production and consumption seriously.

Charcoal production is considered the major cause of deforestation, mostly on account of unsustainable harvesting and inefficient production techniques. Furthermore, about 10 to 15 percent of charcoal is wasted along the supply chain, forming dust or fines resulting from breakage during handling; this dust can be found mainly at retail and wholesale stalls. Faced with the disposal challenges of charcoal dust, slum communities have turned to making charcoal briquettes from recovered charcoal dust. In Kenya, the use of fuel briquettes is spreading among both urban and rural households, and there is a significant potential for briquettes to become an affordable cooking fuel.

Substituting electricity and/or liquid petroleum gas (LPG) for charcoal should be considered as a remedy to reduce the pressures of deforestation and health risks from indoor pollution. However, poor, urban families' preference for using the same energy source for both space heating and cooking often leaves charcoal the only viable option. Few poor households can afford to switch to an alternative energy source such as kerosene, LPG, or electricity, due to high cost and irregular supply. It is expected that biomass, including charcoal, will continue to be the preferred domestic energy source in the future, as households do not climb the energy ladder when their income increases; instead, a phenomenon known as fuel-stacking is observed. Fuel-stacking is a behavior in which households use a variety of fuels to meet their daily energy needs rather than switching entirely to a single fuel, For example, a household may use kerosene and charcoal, charcoal and LPG, or kerosene, LPG, and charcoal.

It is crucial to understand the factors that affect the consumption patterns of cooking fuel, that is, the substitution and diversification of energy sources among lower-income urban households in SSA, rather than simply assuming the energy ladder hypothesis is valid for them. There is a need a more policy-relevant and realistic theory of household energy demand, because policies that ignore fuel-stacking may provide fewer benefits than expected. We must enhance our understanding of the transition from charcoal to kerosene, the most important modern energy option for the poor in Nairobi, and the adoption of charcoal briquette as both a substitute and complement to charcoal.

1.2 The objectives of this study

This study focuses on residents of Nairobi's slums as example of urban poor in SSA. Empirical evidence from urban Africa should contribute to refining energy development theories as well as methodologies for the analysis of the urban poor population.

The primary aim of this study is to better understand the relative importance of fuel substitution and fuel complementation, especially with regard to charcoal, fuel briquettes, and kerosene. More specifically, we analyze the determinants of fuel preferences for poor, urban households. For the analysis, a choice experiment based on a stated preference survey of Nairobi slum-dwellers is employed and a conditional logit (CL) model and a random parameter logit (RPL) model are applied.

The starting point of this study is to understand the current situation of wood-based fuel production and consumption in Kenya. To this end, the next chapter provides political background and examples of strategies and programs related to biomass energy. Chapter 3 and 4 provide case studies of Nairobi's Kibera slums.

CONCLUSION AND IMPLICATIONS

The main objective of this thesis has been to understand the relative importance of fuel substitution and fuel complementation, especially with regard to charcoal, fuel briquettes, and kerosene, by examining the determinants of poor, urban households' fuel preferences. Chapter 3, 4, and 5 then presented case studies regarding the Kibera slums of Nairobi, Kenya.

Chapter 3 found that fuel charcoal briquettes provide affordable and high-quality cooking energy for households in poor, urban slums. Fuel briquettes can provide the urban poor with cheap, clean cooking energy that helps them to direct their income to other necessities, such as food, health, and education. Of the 199 survey respondents, 99.5 percent were aware of fuel briquettes. Those who had used the briquettes identified their preferred qualities—long burning time, low cost, less smoke, and less ash. From the results of the survey, charcoal briquettes can be evaluated as both an alternative and a complementary energy source for domestic use among the sample households in the Kibera slum.

Chapters 4 and 5 analyzed patterns of fuel use, fuel spending, and fuel switching among slum households, using detailed energy-specific information from our survey. In general, households in our study, regardless of their extent of urbanization, strongly prefer to use charcoal for cooking their traditional foods. Kerosene is used for quick frying of meat and vegetables, but charcoal is preferred for slow boiling of maize. Furthermore, in preparing the main meal of the day, maize is first steamed using firewood or charcoal and then heated using the stove. It appears that cooking preferences are important influences in the continuing use of biomass fuel by households despite the accessibility of other energy sources. Households in our study may use biomass fuel in part for economic reasons, for example, long cooking time, but their preferred use of charcoal and briquettes for boiling maize is clearly a cultural preference. The analysis in this study confirms

that household income also exerts a robust influence on fuel choice. Multiple fuel usage, or fuel stacking, is very common among poor, urban poor households.

In conclusion, the results of this study are generally compatible with the energy ladder theory, in which the use of biomass fuel by urban households has declined while their use of modern energy sources such as kerosene has increased. At the same time, however, the continuing extensive use of charcoal or multiple fuels for cooking by well-off households in all of these communities supports the fuel-stacking model. Although people in slums and rural villages can be expected to make greater use of LPG and electricity in future years if the current rapid pace of economic development continues, it is also probable that they, like their already urbanized counterparts today, will persist in using woody biomass for cooking many culturally favored dishes. Therefore, it appears likely that biomass will remain an important source of household energy in Kenya for an extended period.

The contribution of woody biomass to welfare and economic activities in the country is enormous and should be directly addressed by the energy policy. This can be done by the government working with all the stakeholders to attain sustainability in the charcoal sector. There is a need to make institutions aware of the long-term effects of charcoal use and to establish mechanisms to ensure that consumption is matched by replanting of felled trees. In Kenya, the government plays a vital role as the key initiator in the realization of a sustainable charcoal production and use system, though a multi-sectional, integrated approach. First, we would like to make the following recommendations to reduce pressures on deforestation:

- Development of plantations for woody biomass, such as wood fuel and charcoal, by Kenya Forest Services (KFS)
- Adoption of farms for tree planting and agroforestry, with proper management and appropriate choice of tree species
- Efficient management of forests and drylands

Furthermore, it is urgent that the lack of cross-sectional, integrated approaches to charcoal management be addressed. Integrated approaches to managing charcoal access and use will facilitate the development and adoption of appropriate technologies for charcoal production.

- Development and adoption of innovative technologies, such as gasification and briquetting of biomass, for the supply of cheaper and cleaner cooking fuel
- Enabling of an institutional and legal framework for charcoal
- Building awareness so that each participant recognizes the value of a particular practice

Energy policies should promote choice, innovation, and cost-effectiveness, by removing barriers to access, where such barriers exist, and considering lowering costs of adoption.